REMARKS/ARGUMENTS

The Applicants have carefully considered this application in connection with the Examiner's Action and respectfully request reconsideration in view of the foregoing amendment and the following remarks.

The Applicants originally submitted Claims 1-22 in the application. Claims 12 and 21 were cancelled without prejudice or disclaimer in a previous response, and Claims 9, 10, 18 and 19 were subjected to a restriction requirement and withdrawn by the Examiner. Claims 1, 11, 14 and 20 are amended herein without prejudice or disclaimer. New Claims 23-26 are presented for examination. Accordingly, Claims 1-11, 13-20 and 22-26 are currently pending in the application, and Claims 1-8, 11, 13-17, 20 and 22 are subject to examination.

The claim amendments are supported at ¶¶ [0017], [0043] and [0047]. New Claims 23-26 are supported by, *e.g.*, Equation 1.

An affidavit by Ut-Va Koc is respectfully submitted herewith that places various factual evidence into the record.

I. Rejection of Claims 1-8 and 14-17 under 35 U.S.C. § 103

Claims 1-8 and 14-17

The Examiner has rejected Claims 1-8 and 14-17 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 7,130,366 B2 to Phanse, *et al.*, in view of Walach, *et al.*, "The Least Mean Fourth (LMF) Adaptive Algorithm and its Family," IEEE Transactions on Information Theory, Vol. IT-30, No. 2, pages 275-83 (March 1984) (Walach), and A. Zerguine, "Convergence Behavior of the Normalized Least Mean Fourth Algorithm," Conference Record of the Thirty-Fourth

Asilomar Conference on Signals, Systems, and Computers, 2000, 29 Oct.-1 Nov. 2000, Vol. 1, pages 275-78 (Zerguine).

The Examiner has rejected Claims 1-6 and 14-17 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,718,087 B2 to Choa, in view of Walach and Zerguine. Claims 7 and 8 are rejected over the combination of Choa, Walach, and Zerguine in further view of U.S. patent No. 5,048,058 to Kaleh.

The Applicants respectfully traverse the rejections, because the combinations of references as applied by the Examiner do not support a *prima facie* case of obviousness. To establish a *prima facie* case of obviousness, the Examiner must show by a preponderance of the evidence, *i.e.*, that it is more likely than not, that one of ordinary skill in the art would combine the references as applied by the Examiner. (*See In re Oetiker*, 977 F.2d 1443, 24 USPQ2d 1443 (Fed. Cir. 1992).) This he has failed to do.

At pages 2-4, the Office Action states that Zerquine teaches advantages of NLMF over the LMS and NLMS algorithms and that said advantages would have motivated one of skill in the art to modify Phanse and Choa in a manner to arrive at claim 1 and 14. At pages 6-7, the Office Action cites *KSR v. Teleflex*,[1] arguing "the Examiner recognizes that when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has a good reason to pursue the known options within his or her technical grasp." (January 7 Action, pages 6-7.) For several reasons, the above considerations would not have caused a person of skill in the art to modify Phanse or Choa in the manner suggested in the

[1] *KSR International Co. v. Teleflex, Inc.*, 127 S.Ct. 1727, 1732, 82 U.S.P.Q.2d 1385, xxxx (2007)

Office Action. For several reasons, the modifications of Phanse and Choa as proposed by the Office Action are improper.

First, on the one hand Phanse assumes Gaussian noise in his computations. (*See*, *e.g.*, column 13, lines 33 and 52, column 15, lines 15, 18 and 45.) Phanse explicitly ignores nonlinearities. (*See*, *e.g.*, column 13, lines 9 and 28-29.) On the other hand, Walach teaches that a least mean square (LMS) algorithm outperforms LMF for Gaussian noise. (*See* page 280, last ¶.) Thus, a combination of Phanse and Walach is improper because Walach teaches away from using LMF for the type of noise disclosed in Phanse, *i.e.*, Gaussian noise. Zerguine fails to rehabilitate Walach. Zerguine addresses performance of an LMF algorithm for uniformly distributed noise with zero mean.[2] (*See* page 277, 4th and 5th lines below Table 2.) But, uniformly distributed noise is totally different from the type of noise disclosed in Phanse, *i.e.*, Gaussian noise. (*Compare, e.g.*, Walach Figure 3(a) and Figure 3(b); *see* text below Figure 3.) Instead, one of skill in the art would have selected the LMS algorithm that the cited references imply to be the best algorithm for the type of noise found in Phanse. The parts of Zerguine cited by the Office Action fail to teach anything that would have motivated one of skill in the art to apply an LMF algorithm to Phanse due to the very different type of noise discussed therein. Walach's teaching that LMS outperforms LMF for Gaussian noise would have directed one of skill in the art to use the LMS algorithm in Phanse. Accordingly, the combination of Phanse with Walach and Zerguine does not support a *prima facie* case of obviousness because the references teach away from the combination suggested in the Office Action.

Regarding the combination of Choa, Walach and Zerguine, one of ordinary skill in the art would also not find a reason to combine these references as done in the Office Action. In particular,

the Office Action does not address the type of noise encountered by Choa. However, one of ordinary skill in the optical arts would typically assume that electrical noise is Gaussian noise for several reasons. First, non-Gaussian noise is typically small compared to Gaussian noise in optical systems. (*See, e.g.,* Koc aff. ¶ 5). Second, an assumption of Gaussian distribution provides for simple characterization of the distribution by determining the mean and variance of a signal of interest in an experimental setting. (*See, e.g., id.*) Third, the assumption of Gaussian noise is mathematically convenient for simplification of certain system-level parameters such as, *e.g.*, bit error rate (BER). (*See, e.g., id.*) Even Ramaswami, in the portion cited by the Examiner, assumes Gaussian noise in the calculation of bit error rates. (*See, e.g., infra*, p. 258.) Indeed, the Examiner has not cited any evidence that Choa teaches contrary to this assumption.

Moreover, Choa addresses certain improvements in the context of optical communications over multimode fiber (MMF). Multimode fiber is generally limited to applications with a span length on the order of 1 km. (*See, e.g.*, Koc aff. ¶ 6b.) This span of fiber is not generally long enough to result in a significant degree of optical noise because optical amplification is generally not necessary. (*See, e.g., id.*) Without some evidence, not cited by the Examiner, that Choa's system produces significant optical noise, the output of a photodiode receiving an optical signal from Choa's system would thus be interpreted by one of ordinary skill in the art to include only Gaussian noise.

Thus, Choa impliedly teaches Gaussian electrical noise. By reasoning analogous to that set forth above with respect to Phanse, the combination of Walach and Zerguine would teach away from modifying Choa as proposed in the Office Action, because Walach teaches that the LMS algorithm

[2] This type of noise is illustrated in Walach, Figure 3(b).

performs best for Gaussian noise. Therefore, the combination proposed in the Office Action is improper, and the *prima facie* case of obviousness fails.

Finally, the technical papers on which the Examiner relies are from nonanalogous arts. Walach was published in IEEE Transactions on Information Theory, and Zerguine in proceedings from a conference on Signals, Systems and Computers. These art areas are not analogous to the optical arts, and the Examiner has not argued that they are. Moreover, while the Supreme Court stated that "any need or problem known in the field of endeavor at the time of the invention and addressed by the patent [or application at issue] can provide a reason for combining the elements in the manner claimed" (127 S.Ct. at 1732), the Examiner has not shown that the problem addressed in the application[3] was known in the field of endeavor at the time of the invention. The standard for obviousness is what one of ordinary kill in the art knows at the time of the invention. (*See In re McLaughlin,* 443 F.2d 1392, 1395, 170 USPQ 209, 212 (CCPA 1971).) Without placing such evidence in the record, the Examiner is improperly relying on hindsight analysis in combining the references. Such hindsight is, of course, impermissible. (*See* MPEP § 2141.01 ¶ III.) Moreover, the age of Walach's paper is strong evidence of the nonobviousness of the use of the LMF method in the optical arts. Walach was published almost 20 years prior to the filing date of the present application. If the use of the LMF method as the references are applied by the Examiner were as obvious as he purports, the method would likely have been adopted long before the filing date of the Application. On the contrary, the Examiner has failed to present any evidence that the LMF method has been adopted or even considered in the optical arts prior to the filing date of the Application. Thus, the

[3] *See, e.g.*, ¶ [0017], "the [LMS] algorithm … becomes suboptimal for optical noise in the sense that an optical signal to noise ratio … penalty is observed even without the presence of PMD-induced intersymbol interference…"

combination relies on improper hindsight analysis, and does not support a *prima facie* case of obviousness.

In view of the foregoing remarks, the cited references do not support the Examiner's rejection of Claims 1-8 and 14-17 under 35 U.S.C. § 103(a). The Applicants therefore respectfully request the Examiner withdraw the rejection.

Claims 11, 13, 20 and 22

Claims 11, 13, 20 and 22 are rejected over Phanse in view of Ramaswami, *et al.*, "Optical network: A Practical Perspective," Second Edition, Morgan Kaufmann, 2002, pages 258-63 (Ramaswami). The Applicants respectfully traverse the rejection because one of ordinary skill in the art would not be motivated to combine the references as done by the Examiner.

The Examiner cites Phanse for each element of Claims 11 and 20 except adjusting the threshold based on signal distribution. He looks to Ramaswami to teach "that decision threshold should be chosen based on probability density function of the "0" and "1" of the data stream." *See* January 7 Action at 7.) However, the references as applied by the Examiner do not teach "a slicer configured to track variance of said electrical signal and dynamically adjust a slicing threshold based on a history of said variance to maintain an optimum slicer threshold to produce a predicted signal in response to each input signal," as recited in amended Claim 11, *e.g.* (emphasis added). As applied by the Examiner, Ramaswami only teaches a static variance of the statistical distributions of 1s and 0s. Absent the recognition that the variance of the distribution of 0s and 1s may change over time, one of ordinary skill in the art would not find any reason to modify Phanse as proposed by the Examiner. In the pending application, the inventors made the nonobvious recognition that nonlinear optical

contributions to received signal streams may produce undesired time-varying and non-negligible contributions to an electrical signal produced by a photodiode from an optical signal received from a long-haul optical transmission path. Of course, removing non-Gaussian noise from the electrical signal includes reducing the level non-Gaussian noise relative to its initial value. Therefore, one of ordinary skill in the art, lacking such recognition, would not have found it obvious to modify Phanse as the Examiner proposes.

Accordingly, the record does not support the Examiner's rejection of Claims 11, 13, 20 and 22 under 35 U.S.C. § 103(a). The Applicants therefore respectfully request the Examiner withdraw the rejection.

II. Conclusion

In view of the foregoing amendment and remarks, the Applicants now see all of the Claims currently pending in this application to be in condition for allowance and therefore earnestly solicit a Notice of Allowance for Claims 1-8, 11, 13-17, 20 and 22-26.

The Applicants request the Examiner to telephone the undersigned attorney of record at (972) 480-8800 if such would further or expedite the prosecution of the present application. The Commissioner is hereby authorized to charge any fees, credits or overpayments to Deposit Account 08-2395.

Respectfully submitted,

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